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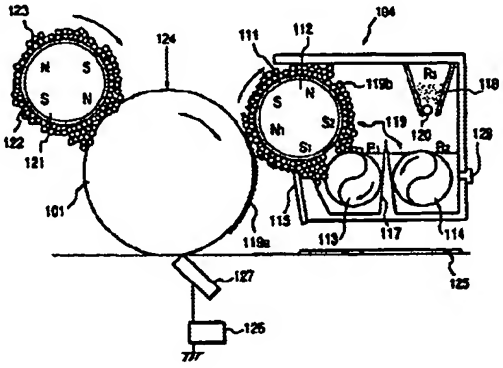
## (54) Two-component type developer and image forming method

(57) A two-component type developer has a negatively chargeable toner having toner particles and an external additive and a magnetic-fine-particle-dispersed resin carrier. The magnetic-fine-particle-dispersed resin carrier has composite particles containing at least inorganic compound particles and a binder resin. The inorganic compound particles have been surface-treated with a lipophilic-treating agent having at least one type of functional group (A) selected from the group consisting of an epoxy group, an amino group, a mercapto group, an organic acid group, an ester group, a ketone group, an alkyl halide group and an aldehyde group, or a mixture of the agent. The composite particles have been surface-coated with at least one type of coupling agent having at least one type of functional group (B) different from the functional group (A) the lipophilic-treating agent. The functional group (B) the coupling agent has being a functional group or groups selected from the group consisting of an epoxy group, an amino group and a mercapto group. The negatively chargeable toner has a weight-average particle diameter of from 3 μm to 9 μm.

FIG. 1

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Descripti n

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a two-component type developer employing a magnetic carrier, used to develop electrostatic imagesused to develop electrostatic images in electrophotography, electrostatic recording and so forth. It also relates to an image forming method.

Related Background Art

[0002] As electrophotography, various methods are disclosed in U.S. Patent No. 2,297,691, Japanese Patent Publications No. 42-23910 and No. 43-24748 and so forth. In these methods, copies or prints are obtained by forming an electrostatic latent image on a photosensitive layer of an electrostatic image bearing member upon irradiation of a light image to form an electrostatic image, subsequently causing a toner to be attracted onto the electrostatic image to develop it to form a toner image, and transferring the toner image to a transfer medium such as paper as occasion calls, followed by fixing by heat, pressure, heat and pressure, or solvent vapor.

[0003] In the step of developing the electrostatic image, the toner image is formed by utilizing an electrostatic mutual action between a toner triboelectrically charged and the electrostatic image. Among methods of developing electrostatic images by the use of toners, a developing method making use of a two-component type developer formed of a blend of toner and carrier is commonly preferably used in full-color copying machines or printers which are required to form high-quality images.

[0004] In such a developing method, the carrier imparts positive or negative electric charge to the toner in an appropriate quantity by triboelectric charging, and carries the toner on its surface by electrostatic attraction attributable to the triboelectric charging.

[0005] The developer having the toner and the carrier is coated on a developing sleeve internally provided with a magnet, in a prescribed layer thickness by means of a developer layer thickness regulation member, and then transported, by utilizing a magnetic force, to a developing zone formed between the electrostatic image bearing member (photosensitive member) and the developing sleeve.

[0006] A certain development bias voltage is kept applied across the photosensitive member and the developing sleeve, and the toner participates in development on the photosensitive member in the developing zone.

[0007] There are various performances required for the carrier. Especially important performances may include appropriate charging performance, breakdown strength to applied voltage, impact resistance, wear resistance, spent resistance and development contribution.

[0008] For examp'ı, when developers are used for a long term, a toner called a spent-toner, which does not contribute to the development, may melt-adhere to the carrier surface to cause toner filming, so that this causes a deterioration of the developer and concurrently with it a deterioration of image quality of developed images.

[0009] In general, a carrier having too large a true specific gravity may apply a great load on the developer when the developer is formed on the developing sleeve in a prescribed layer thickness by means of the developer layer thickness or when the developer is agitated in a developing assembly. Thus, such a carrier may cause (a) toner filming, (b) carrier break and (c) toner deterioration. As the result, this tends to cause the deterioration of developer and concurrently with it the deterioration of image quality of developed images.

[0010] With an increase in particle diameter of carriers, the load applied to developer increases like the above, and hence the above (a) to (c) tend to occur, so that the deterioration of developer tends to occur. Also, (d) fine-line reproducibility in the developed images tends to lower.

[0011] Accordingly, carriers tending to cause the above (a) to (c) make it necessary to take time and labor to change developers for new ones periodically. Also, since such carriers are uneconomical, it is desirable to lessen the load applied to developers or to improve the impact resistance and spent resistance of carriers so as to prevent the above (a) to (c) and elongate the service life of developers.

[0012] Making the carrier have a smaller particle diameter makes (e) the carrier tend to adhere to the electrostatic image bearing member. Also, in an instance where the toner has a constant particle diameter and only the carrier is made to have a small particle diameter, (f) the toner has a broader charge quantity distribution to tend to cause a phenomenon that a toner having caused charge-up flies unwantedly to non-image areas (hereinafter called "fog") especially when developed in an environment of low humidity.

[0013] As a carrier to solve the above problems (a) to (f), a magnetic-fine-particle-dispersed resin carrier is known in the art. This carrier has particles having less shape-originating strain, can relatively easily be made spherical, giving a high particle strength, and has a good fluidity. It also enables wide-range control of particle size distribution. Hence,